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ABSTRACT

Using the High School and Beyond 1980 to 1982 Longitudinal Study data base, this paper focuses on cognitive growth as evidenced by changing scores on achievement tests of adolescents during their last two years of high school. The analysis had two major phases: (1) a descriptive analysis which provided a variety of cross tabulations of change in the major variables of this study between the students' sophomore and senior years in high school, and (2) a relational analysis to identify the determinants of the gains in tested achievement. This paper is divided into four sections. The first section describes the background characteristics of the high school sophomores and their families in 1980. The second section describes the changes in achievement test scores from 1980 to 1982. The third section documents the changes in school-related behaviors; and aspirations, attitudes and values of the students between their sophomore and senior years. All three of these sections are based on the descriptive analysis. The fourth and final section, which is based on the relational analysis, identifies the individual characteristics and behaviors that were related to test score changes. (PN)

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GROWTH IN HIGH SCHOOL:

A LONGITUDINAL STUDY 1980 TO 1982*

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Paper presented at the symposium, "How Do High Schools Affect Student Development?" American Educational Research Association Annual Meeting, Chicago, Illinois, April 3, 1985

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GROWTH IN HIGH SCHOOL: A LONGITUDINAL STUDY 1980-1982

Ruth B. Ekstrom

In this paper I will discuss the changes that occur in adolescents during their last two years of high school. I will focus on cognitive growth as evidenced by changing scores on achievement tests. I will also discuss changes in students' educational and occupational aspirations, behaviors, attitudes and values.

This paper uses the High School and Beyond 1980 to 1982 Longitudinal Study data base. Data was collected in 1980 from a national probability sample of about 30,000 students who were sophomores in about 1,000 secondary schools. A follow-up of these same individuals, done in 1982, obtained data from over 21,000 students still in high school who were then seniors. Data was also collected from over 2,000 individuals who had become dropouts. My paper will focus on changes among the students who remained in high school. It will be followed by a paper (Rock, 1985) which focuses on the dropouts, and a paper (Goertz, 1985) which deals with the school processes and policy implications.

This longitudinal data base has several advantages over the cross sectional 1972 and 1980 data used in the study just reported by Hilton (1985). The panel design that provides information on the same students in the same schools at two points in time. The expanded sample provides better information about minority group members. The test battery and

questionnaire were also improved. Tests in science and in writing were added to the earlier tests of vocabulary, reading, and mathematics and the test battery was the same at both points in time. The contents of the student questionnaire were expanded and there are more comparable questions at the two data collection points. Finally, transcripts were available for analysis for a large proportion (more than 12,000) individuals of the students who remained in high school.

Research Questions

The major research questions which I will be addressing in this paper are:

- How do American high school students change during their last two years of high school?
  - In cognitive achievement
  - In educational and occupational aspirations
  - In school-related behaviors
  - In out-of-school behaviors
  - In attitudes and values
- What individual factors account for the growth in students' cognitive achievement?
  - Demographics
  - Family influences
  - Attitudes
  - Student behaviors

Methodology

The analysis had two major phases: (1) a descriptive analysis which provided a variety of cross tabulations of change in the major variables of this study between the students' sophomore and senior years in high school,

and (2) a relational analysis to identify the determinants of the gains in tested achievement. More information about the methodology is available in Rock (1985b). To give you a brief overview of the methodology, we first created a logical model of the factors that affect cognitive growth, based on the individual development and school improvement literature. The model is shown in Figure 1. We hypothesized that the outcome--1982 tested achievement--was related to demographics, family educational support, 1980 tested achievement and attitudes, the education delivery agent, and school behaviors. We then tested this model using path analysis. This involved first identifying variables whose associated raw weights were at least four times their standard error and then determining the direct and indirect effects of those variables on later explanatory variables in the model and on the major outcome variable, 1982 tested achievement.

The remainder of this paper is divided into four sections. The first section describes the background characteristics of the high school sophomores and their families in 1980. The second section describes the changes in achievement test scores from 1980 to 1982. The third section documents the changes in school-related behaviors; out-of-school behaviors; and aspirations, attitudes and values of the students between their sophomore and senior years. All three of these sections are based on the descriptive analysis. The fourth and final section, which is based on the relational analysis, identifies the individual characteristics and behaviors that were related to test score change. A more detailed report of these analyses can be found in Rock, et al (1985).

Student and Family Background Characteristics in the Sophomore Year

It is estimated that in 1980, approximately 78 percent of the sophomores who were to remain in high school were White, 13 percent Black,

and 7 percent Hispanic. Approximately 90 percent of these students were enrolled in public high schools, 7 percent in Catholic schools and 3 percent in other private schools. The average age was 15.5. About 74 percent of these sophomores lived with both natural parents, 13 percent with their mother only, 7 percent with a natural and a step parent and the remainder in other family structures. The typical student reported that his or her parents kept close track of school progress, but that parental involvement with the school was low. The typical family provided a variety of study aids in the home, such as books and a place to study, and also provided a variety of opportunities for non-school learning, such as travel, trips to museums and music lessons. There were substantial variations on many of the background measures, especially across socio-economic groups.

Tested Achievement

The students made significant gains on all achievement tests between their sophomore and senior year in high school. The test score means and gains are summarized in Table 1.

Table 2 shows the test score gains by major subgroups (sex, race/ethnicity, socio-economic status, and curriculum). In most cases the test score gains were greater for students in the academic curriculum than for students in the general and vocational curricula. There was no difference across curricula in gains on the writing test, and there was little variation in gains on the science test. This suggests that these two measures may be less sensitive indicators of the impact of some school processes than the other three tests.

Post-High School Educational and Occupational Plans

The percentage of students planning some type of post-secondary education remained relatively steady but there was a shift in the type of post-high school education planned. Between their sophomore and senior years, the percentage of students planning to enter a four-year college declined from 41 to 35 percent, while the percentage planning to enter an academic program in a two-year college rose from 6 to 10 percent. There was a small increase in the proportion of students planning to work full-time directly after high school. (Approxmately 27 percent of sophomores and 30 percent of seniors.)

Occupational aspirations also changed between the sophomore and senior year. The percentage of students aspiring to professional occupations such as doctor, lawyer, or college professor decreased (from about 14 percent to about 10 percent) while the proportion aspiring to professional occupations such as engineer, accountant or nurse increased (from 25% to 27%). There were also increases in the percentage of students planning to enter technical occupations (8% to 11%) and managerial occupations (4% to 8%).

School-Related Behaviors

A number of students moved out of the general curriculum into the vocational or academic curricula during the last two years of high school. In their sophomore year, 44 percent of the students who would remain in high school were enrolled in the general curriculum, 36 percent in the academic curriculum, and 20 percent in the vocational curriculum. By the senior year, 33 percent of the students reported being in the general curriculum, 40 percent in the academic curriculum, and 27 percent in the vocational curriculum.

While the transcripts showed that students in each curriculum took approximately the same number of Carnegie units (22) during their four years of high school, there was considerable variation in the number of courses taken in the "New Basics"[1].

The typical student in the academic curriculum took and passed approximately 15.5 units in the "New Basics", while the typical student in the general curriculum took approximately 12 units in the "New Basics" and the typical vocational education student took 11 units in the "New Basics". Viewed another way, approximately two-thirds of the courses taken by academic students were in the "New Basics" but only half of the courses taken by general and vocational curriculum students were of this type. For the academic curriculum student, approximately 14.9 units in the "New Basics" were beyond the remedial or functional level[2], compared with 11.0 units and 10.3 units, respectively, beyond the remedial or functional level for the general and vocational curriculum students.

There were also racial/ethnic, and gender differences in course-taking behavior within each of the curricular areas. For example, in the academic curriculum, males take 1.35 units of advanced mathematics (Algebra II, Geometry II, Trig, Calculus, etc.) but females take only 1.14 units. Whites take 1.32 units of advanced mathematics, Blacks 0.73 units, and Hispanics 0.87 units.

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[1]For purpose of this analysis, we have defined the "New Basics" as including courses in English, Mathematics, Science, Social Studies, Foreign Language and Computer Science.

[2]Remedial and functional level courses include remedial English, remedial reading, basic skills math, functional biology, and functional social science.

Self-reported grades showed a very slight rise between the sophomore and senior years. (From approximately 2.77 to 2.84 on a scale where 3 is a B and 2 is a C.) Both the self reported grades and the transcript analysis indicated considerable variation across curricula. The transcripts showed that the typical student in the academic curriculum had a grade-point-average (GPA) of approximately 2.9 while typical general and curriculum students had a GPA of approximately 2.1 for all four years of high school.

The mean amount of homework done by students decreased very slightly between the students' sophomore and senior years, but averaged at only about four hours a week at both points in time.

All types of school attendance problems (unexcused absences, tardiness, cutting classes, being placed on suspension or probation) increased during the last two years of high school. Cutting classes was done by 24 percent of the students when they were sophomores but 43 percent of them when they were seniors. Serious discipline problems were reported by 15 percent of the sophomores but only 13 percent of the seniors.

Non-School Behaviors

Students were more likely to do paid work as seniors than as sophomores (64 versus 42 percent) and to work more hours a week (approximately 16 hours per week in the senior year compared to 9 hours per week in the sophomore year). The most common jobs for sophomores were child care and lawn work; for seniors the most common jobs were food service and clerical work. Attitudes toward work became more positive as the students became older.

Students watched less televison as seniors (approximately 2 hours per day) than as sophomores (3 hours per day). The students also showed changes in other out-of-school activities, including spending more time as seniors than as sophomores in dating, talking with friends, and driving/riding around.

Attitudes and Values

Students placed less importance as seniors than as sophomores on altruistic values, such as working to correct social and economic inequities, and/or being a leader in their community. Self-concept became more positive by 1982 than in 1980. Seniors also showed an increased sense of control over their lives. Students were less likely to hold stereotyped sex role attitudes as seniors than as sophomores.

What Individual Factors Accounted for Gains in Achievement?

The school effectiveness research has brought considerable attention to the differences in educational outcomes for White and minority students. Individuals concerned with sex equity in education have drawn attention to differences in educational outcomes for females and males. Therefore we examined both the relative gains in achievement across different groups of students. These results are shown in Tables 3 and 4. I want to stress that the relative adjusted gains are controlled for the major explanatory variables. In short, they represent the situation that would exist if all students were similar except for race/ethnicity or sex.

I want to emphasize that there were gains in all achievement areas for all groups of students. Although Whites had more relative gain than Blacks and Hispanics on four of the five achievement tests (there was no difference in reading achievement), only the differences in vocabulary and science are large enough to be of any practical significance. The

vocabulary test difference is not surprising since we know that vocabulary is probably more affected by non-school influences than are other areas of achievement. Males showed greater relative gains than females on four of the five tests but probably only the difference on the science test is of any practical significance. Females showed greater relative gains than males on the writing test.

Determinants of Achievement Gain

As indicated earlier, path analysis was used to identify those factors that determined achievement gains. Table 5 summarizes the direct effects of the explanatory variables on 1982 tested achievement and highlight those demographic characteristics, student behaviors and attitudes that were found to affect gains either directly or indirectly on (indirect effect means that a particular variable or class of variables seem to affect changes in some other student behavior which in turn has been shown to have direct impact on gains).

As can be seen, 1980 tested achievement had the largest direct effect on 1982 tested achievement in each achievement area. Tested 1980 achievement in related areas (eg, vocabulary for reading) also had large direct effects.

Students' school behaviors had a significant effect on all areas of tested achievement. The most important of these school behaviors were:

- Course exposure. In each achievement area tested, the number of courses in the "New Basics" that a student took beyond the remedial or functional level was positively related to test score gains. For example, there was a positive relationship between the number of mathematics courses taken and gains on the mathematics achievement test.

- Curriculum. Although students enrolled in the academic curriculum showed greater gains than did students enrolled in the general and vocational curricula, curriculum had an indirect, rather than a direct, effect on the 1982 test scores, working through the number of relevant courses taken. This suggests that curriculum choice may be linked with access to courses in the New Basics.
- Homework. Other things being equal, students who did more homework showed greater test score gains. Hours of homework done had a positive direct effect on all 1982 tests.
- Disciplinary Problems. Students who had disciplinary problems showed less gain in mathematics, science, and writing.

Students' background, family influences and attitudes had a less consistent impact on achievement gains. Mother's educational aspirations for her child had a direct impact on gains in vocabulary, mathematics and writing. Non-school related opportunities for learning--such as travel, trips to museums, and music lessons--had a small impact on gains in vocabulary and science. All of the family educational support variables tended to have an indirect impact on gains, working through student school behaviors which, in turn, had direct impacts on gains. Family structure had no direct effect on achievement. Locus of control--the extent to which individuals believe success or failure depends on their own initiatives rather than factors that cannot be controlled--was significantly and positively related to gains in vocabulary, reading and writing.

We can conclude from these findings that school-related individual behaviors play a major role in explaining achievement gains in the last two years of high school. These behaviors include taking more courses in the "New Basics" and doing more homework. These behaviors are effective

regardless of race/ethnicity, sex or school type. That is a similar impact for all groups of students, whether White or Black, male or female, enrolled in public or a private school.

If I were going to advise students entering high school about how to make the most of the educational opportunity that is before them, my first recommendation would be that they take as many courses as possible in the New Basics. Next, I would urge students to investigate the limitations that may be associated with the general or the vocational curriculum carefully before making any curriculum choice. Finally, I would urge students to be conscientious about their homework. Doing these three things will, I believe, help students optimize their intellectual development during the high school year.

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Table 1

Changes in Tested Achievement for School Stayers, 1980-1982

Test	Sophomore Mean	Senior Mean	Difference	Effect Size
Vocabulary	9.02	11.17	2.15*	0.4
Reading	7.16	8.54	1.38*	0.3
Mathematics	13.43	15.43	2.00*	0.2
Science	9.27	10.23	0.96*	0.2
Writing	8.92	10.61	1.69*	0.3

* Statistically significant increase

Table 2

1980-1982 Test Score Gains by Subgroups of Stayers

Subgroup	Vocabulary		Reading		Mathematics		Science		Writing	
	Gain	Effect Size	Gain	Effect Size	Gain	Effect Size	Gain	Effect Size	Gain	Effect Size
Total	2.2*	0.4	1.4*	0.3	2.0*	0.2	1.0*	0.2	1.7*	0.3
Sex:										
Male	2.0*	0.4	1.4*	0.3	2.3*	0.2	1.0*	0.2	1.6*	0.3
Female	2.3*	0.4	1.4*	0.3	1.7*	0.2	0.9*	0.2	1.7*	0.4
Race/Ethnicity										
White	2.2*	0.4	1.4*	0.3	2.1*	0.2	0.9*	0.2	1.6*	0.4
Black	1.9*	0.4	1.1*	0.3	1.9*	0.2	0.9*	0.2	1.8*	0.4
Puerto Rican	2.1*	0.4	1.3	0.3	1.6	0.2	1.6*	0.3	3.0*	0.7
Mexican American	1.6*	0.3	1.3*	0.3	1.1	0.1	0.9*	0.2	1.8*	0.4
Asian American	2.3*	0.4	1.6*	0.3	2.9	0.3	1.7*	0.4	1.7*	0.4
American Indian	2.1*	0.4	1.3	0.3	1.1	0.1	0.8	0.2	1.7	0.3
SES:										
Low	2.0*	0.4	1.3*	0.3	1.3*	0.1	0.9*	0.2	1.7*	0.4
Middle	2.2*	0.4	1.4*	0.3	1.9*	0.2	1.0*	0.2	1.7*	0.4
High	2.3*	0.5	1.5*	0.3	2.8*	0.3	0.9*	0.2	1.6*	0.4
Curriculum:										
Academic	2.4*	0.5	1.6*	0.3	3.3*	0.3	1.1*	0.3	1.7*	0.4
General	2.1*	0.4	1.3*	0.3	1.4*	0.2	0.9*	0.2	1.7*	0.4
Vocational	1.9*	0.4	1.1*	0.3	0.7*	0.1	0.8*	0.2	1.7*	0.3

*Significant gains

Table 3
White Relative Adjusted Gains in Comparison to Minorities*
(Pre-Test Standard Deviation Units)

	Vocabulary	Reading	Mathematics	Science	Writing
Compared to Blacks	+.17	No diff	+.06	+.25	+.11
Compared to Hispanics	+.16	+.02	+.09	+.12	+.04

*Differences less than .10 SD are probably too small to be of practical significance.

Table 4
Male Relative Adjusted Gains in Comparison to Females*
(Pre-Test Standard Deviation Units)

	Vocabulary	Reading	Mathematics	Science	Writing
Compared to Females	+.02	+.05	+.10	+.19	-.29

*Differences less than .10 SD are probably too small to be of practical significance.

Table 5
Summary of Direct Effects of Explanatory Variables on 1982 Tests
All Students Who Remained in High School

Standardized Regression Weights

	Vocabulary	Reading	Mathematics	Science	Writing
1980 Test	.51*	.34*	.53*	.43*	.37*
Other 1980 Tests					
Vocabulary	-	.19*	.03*	.11*	.12*
Reading	.11*	-	.03*	.11*	.08*
Mathematics	.02*	.10*	-	.12*	.15*
Science	.10*	.13*	.08*	-	.05*
Writing	.08*	.09*	.04*	.01	-
Sex: Male	.00	.03*	.04*	.09*	-.15*
SES	.03*	.00	.02*	.02	-.02
Region: Non-South	.01*	-.02	.02*	.03*	.00
Community: Non-Rural	.01	.00	.01*	.01	.00
School Type: Public	.00	.01	.03*	.00	.00
Race: White	.06*	.00	.02*	.09*	.04*
Race: Hispanic	.00	.00	-.01	.03*	.02
Mother's Aspirations for Student	.03*	.02	.03*	.02	.04*
Study Aids	.01	.01	-.01	.00	.03*
Non-School Learning	.02*	.01	.01	.02*	.02
Parental Role in Curriculum	-.02*	-.01	-.01	-.01	-.02

Table 5 (Cont'd)

Family Structure	.00	.00	.01	.00	.01
Curriculum: Academic	.01	.01	.02	-.01	.00
Number of Related Courses	.06*	.05*	.22*	.05*	.04*
Hours of Homework	.02*	.03*	.04*	.02*	.05*
Disciplinary Problems	-.01	-.01	-.02*	-.02*	-.05*
Locus of Control	.04*	.03*	.00	.02	.02*

*Significant